

CLASSIFICATION CONFIDENTIAL **CONFIDENTIAL**
 CENTRAL INTELLIGENCE AGENCY REPORT
 INFORMATION FROM
 FOREIGN DOCUMENTS OR RADIO BROADCASTS CD NO.

50X1-HUM

COUNTRY USSR
 SUBJECT Scientific - Geophysics, petroleum
 HOW PUBLISHED Bimonthly periodical
 WHERE PUBLISHED Moscow/Leningrad
 DATE PUBLISHED Nov 1950
 LANGUAGE Russian

DATE OF INFORMATION 1950

DATE DIST. // Sep 1951

NO. OF PAGES 4

SUPPLEMENT TO REPORT NO.

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SOURCE Izvestiya Akademii Nauk SSSR, Seriya Geologicheskaya, No 6, Nov/Dec 1950, pp 136-139.

POSSIBLE CONDITIONS OF ACCUMULATION OF ORGANIC MATTER FOR OIL FORMATION

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The basic laws governing the distribution and formation of oil and gas deposits were formulated in 1932 in I. M. Gubkin's well-known work The Science of Oil. The theory of the mixed animal-vegetable origin of oil which Gubkin presented clarified many problems of oil formation.

In our report, we examine some considerations on the problem of the composition and sources of accumulation of the primary oil-forming organic matter.

Gubkin pointed out that biogenous silts form because of the dying off of plankton and benthos in seas. To these silts are united some components of plants, those growing both on land and in sea basins, which are the source material for the formation of oil and hydrocarbon gases. Understanding the role of organic matter brought into sea basins by rivers, in the over-all balance of organic matter in the given basin, is of great importance for solving the complex problem of the origin of oil and the laws governing the distribution of oil and gas deposits.

At present, chemists still cannot accurately analyze the nature of the organic matter contained in sediments and determine whether it is of vegetable or animal origin. This has led to the development of many one-sided hypotheses concerning the solely vegetable or animal origin of oil and hydrocarbon gases.

The organic matter of animal and vegetable origin which develops in the basin itself is of enormous importance in the formation of oil. At the same time the organic matter brought into sea basins by rivers is also of great importance. It is well known that rivers which flow from huge land masses carry a great deal of organic matter.

In the recently published monograph (1) on the geology of seas, M. V. Klenova observed that "almost all organic matter of the bottom sediments of the Baltic Sea are connected with deposits borne by river waters, while the part of organic

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matter produced in the sea itself is negligible." This conclusion is undoubtedly exaggerated. However, it shows the importance which Klenova attaches to the role of organic matter brought into sea basins by rivers.

A number of other researchers consider that organic matter in seas accumulates mainly at the expense of organisms of the sea itself. There is no clear view on the problem. However, S. V. Bruyevich for example, in studying the balance of biogenous elements in the Caspian Sea (2, 3) came to the conclusion that the amount of biogenous elements present in the Caspian is 100 times as great as the amount of biogenous elements discharged into the Caspian by the Volga, as illustrated by the following figures: the total productivity of the Caspian (including bacterial) is 534,282,000 tons of dry, organic matter per year, while the influx of organic matter in the Volga is 9,660,000 tons.

Bruyevich and N. I. Anishkova (4) stated that the amount of organic matter discharged into the Caspian by river runoff per year is $1 \cdot 10^9$ tons. Thus, according to their data, the amount of organic matter produced in the Caspian Sea is only about 50% of the total organic matter contained in it.

The above figures show that the role of organic matter of autochthonous and allochthonous origin in the over-all balance of the sea is still not clear, but we must agree with Bruyevich's conclusions that "the Volga runoff must play an important role in the balance of biogenous elements."

Organic matter has been borne into sea basins from dry land in all epochs of geological time, but we do not observe universal distribution of oil- and gas-bearing structures in all stratigraphic levels.

The oscillatory movements which follow the accumulation of organic matter in the corresponding depths are an important factor both in the formation of oil and hydrocarbon gases and in the formation of pools. Sinking creates favorable conditions for the accumulation of organic matter and transformation of it into oil. The subsequent processes connected with upthrust of the region and formation of folds favors the formation of oil pools.

A correlation between oscillatory movements and formation of oil and oil pools has been demonstrated by many researchers.

The geographical distribution of oil- and gas-bearing regions shows that geosynclines directly in front of mountains (depressions before the Urals, Caucasus, eastern Caucasus, and Carpathians) are the richest oil-bearing regions. The organic matter which was formed both in local basins and in the enormous surrounding land masses is concentrated in these depressions.

The same thing occurs in intermont basins, but to a slightly lesser degree (from the standpoint of accumulation of organic matter). The oil potentialities of the intermont depression of the Vienna basin (5) are apparently due mainly to the nature of the terrigenous materials and organic matter coming from the Bohemian massif, the Alps, and the Carpathians surrounding the Vienna basin. Our studies show that organic matter borne into the corresponding basins by river systems from the surrounding land play an important role in the over-all balance of organic matter which serves as the source material for oil-formation processes.

In addition, we note that rivers of platform regions are considerably longer than the rivers of mountain regions. For example, the Volga, which drains the vast land area of the Russian platform, is 3,700 km long, while the rivers of the Caucasus mountain system (Kura, Terek, Rioni, and others) are much shorter, generally only several hundred kilometers in length. It has been calculated that all rivers discharge a total of about 325 cu km of water into the Caspian yearly, which comprises about 83% of the incoming part of the water balance. Of this value (325 cu km), the Volga contributes 70%, while the Terek, Sulak, Kura, and Ural rivers contribute 13%, and all the remaining rivers contribute 9% (6).

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Such regularity is clearly observed in Kura, Vienna, Fergana, and other basins of intermont depressions. The rich oil deposits found in the Shirakskoy stratum of the Miopliocene of the Kura depression, and the intensive oil saturation of the Sarmatian and Pannonian deposits of the Vienna and Pannon basins are clear proof of the above conclusion.

We note, however, that all these complex problems demand additional detailed studies. In conducting these studies, we must remember I. M. Gubkin's ideas regarded comprehensive study of the nature of organic material and its conditions of accumulation in marine basins, the manner of transformation into oil and gas, and processes of formation of oil and gas pools.

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